

REMARKS

The Amendments

Applicants have amended claims to change their dependencies. Specifically, applicants have amended claims 3-5, 14-16, 25, 27 and 29 to depend from claim 2. Similarly, applicants have amended claim 6 to depend from claim 1. Applicants have also amended claim 19 to correct its dependency and have amended claims 26, 43, 44, 118 and 119 to depend from claims 25, 40, 43, 115 and 118, respectively.

Further, applicants have amended claims 41 and 116 such that the solvent is capable of making covalent modifications within the small pore area material. This feature was recited previously in each of the independent claims from which claims 41 and 116 depended.

Applicants have also canceled claims 17, 18, 42, 94 and 117 to avoid duplicative subject matter.

Applicants have amended claims 40 and 115 to incorporate from now canceled claims 42 and 117, the recitation that the solvent comprises a carboxylic acid.

No new matter has been added by any of these amendments.

Solely for the Examiner's benefit, the pending claims, as amended, can be considered in the following groups:

(1) independent claims 1 and 2, and dependent claims 3-36, 53, 84, 85, 91-93, 95-112 and 114, which recite an organic, small pore area material comprising a monolithic aerogel in which its smallest dimension is greater than about 3 inches and is substantially free of cracks;

(2) independent claim 37 and claim 38, which recite a small pore area material comprising acetic acid; and

(3) independent claims 40 and 115, and dependent claims 41, 43-51, 116 and 118-126, which recite a small pore area material (claims 40, 41 and 43-51) or a low

density microcellular material (claims 115, 116 and 118-126) comprising carboxylic acid as a solvent.

For at least the reasons discussed below, each group is allowable.

Rejections of the Group 1 Claims

Claims 1 and 2

Claims 1 and 2 stand rejected as allegedly being anticipated by Hrubesh et al., United States Patent 6,005,012 (hereinafter "Hrubesh"). Applicants traverse.

In brief, applicants' invention, as defined by claims 1 and 2, is a monolithic aerogel in which its "smallest dimension is greater than about 3 inches." As the Examiner acknowledges, Hrubesh discloses monolithic aerogels in which its smallest dimension is 1.5 centimeters (Office Action, page 3, line 4). Thus, applicants' claimed monolithic aerogels have a smallest dimension that is over *5 times* larger than that of the Hrubesh aerogels.

Accordingly, because Hrubesh does not disclose each and every element of either claim 1 or claim 2, the rejection under 35 U.S.C. § 102 should be withdrawn.

Further, although the Examiner has rejected claims 1 and 2 as obvious over Hrubesh, the Examiner does not explain why it would be obvious to modify Hrubesh to produce monoliths in which its smallest dimension is greater than about 3 inches.

Nevertheless, because Hrubesh does not teach or suggest such monoliths, Hrubesh does not render obvious applicants' claims 1 or 2. This is so because there was neither the requisite motivation to modify Hrubesh in the manner the Examiner suggests, nor the requisite reasonable expectation of success. (*See, e.g.*, M.P.E.P. § 2142).

These arguments are discussed below in greater detail.

Applicants' invention, as defined by claims 1 and 2, is a monolithic aerogel in which its "smallest dimension is greater than about 3 inches" and is "substantially free of cracks." These aspects of applicants' invention renders it with superior advantages over the organic aerogel monoliths produced previous to applicants' invention. For example, applicants' invention may be made for a wide variety of uses and applications in which thin

sheets and films are impractical. Hrubesh does not render applicants' claimed invention obvious.

Hrubesh teaches a method of creating hydrophobic aerogels by treating pre-formed dried monolithic aerogels. (*See, e.g., Hrubesh abstract*). The organic aerogels used in Hrubesh are prepared by the methods of Pekala, United States Patents 4,873,218, 4,997,804, 5,086,085, and 5,476,878 (hereinafter "the '218 patent," "the '804 patent," "the '085 patent," and "the '878 patent," or collectively as "the Pekala patents"; column 3, 35-47).

As discussed above, Hrubesh does not disclose an organic aerogel monolith in which its smallest dimension is greater than about 3 inches. The largest organic aerogel disclosed in Hrubesh has a smallest dimension of 1.5 cm – over *five times* smaller than applicants' claimed organic aerogel monoliths.

Further, not only is there no suggestion to modify Hrubesh to make an organic aerogel in which its smallest dimension is greater than 3 inches, but Hrubesh teaches away from this aspect of applicants' claimed invention. Hrubesh describes monolithic aerogels of minimum dimension of 2 mm -- over *300 times* smaller than the smallest dimension of applicants' claimed monolithic aerogels -- as "relatively large." (Hrubesh, col. 7, lines 19-24). Thus, even if one were motivated to make a "large" monolithic aerogel, Hrubesh would teach that such monoliths are much smaller than applicants claimed monoliths. And, the above-mentioned Pekala patents, which describe the monoliths used in Hrubesh and are incorporated by reference in Hrubesh, do not teach or suggest an aerogel monolith in which its smallest dimension is greater than about 3 inches.

Moreover, at the time of applicants' invention, there was no suggestion in the generally available knowledge to produce larger monolithic aerogels. Indeed, in another Pekala patent, United States Patent 5,731,360, Pekala teaches away from doing so because it was not feasible to make such monoliths using the methods described in the '218, '804, and '085 patents:

"Although monolithic aerogels, either supercritically-dried or air-dried, are ideal candidates for many applications...the large and expensive processing equipment necessary for producing reasonably sized aerogels has limited the commercial application of this extraordinary material. The formation of aerogel microspheres or powders offers an attractive alternative to monolith production." (col. 1 lines 61- col. 2, line 2).

In other words, Hrubesh discloses aerogels produced by Pekala's methods. Pekala, however, in this subsequent reference teaches away from using those very methods when producing large monolithic aerogels because such methods were not suitable. Indeed, for applications requiring larger materials, Pekala teaches that alternative types of aerogels, not those of applicants' claims, should be used. Thus, even if a need existed for larger aerogels, there was no motivation to produce larger monolithic aerogels as opposed to microspheres or powders.

At the time of applicants' invention, there was also no reasonable expectation of success to make larger monolithic aerogels. Indeed, organic aerogels produced at that time were required to have at least one small dimension because the available drying processes were inadequate to dry larger monoliths. The ability to dry a sol-gel is dependent on the size of the foam. A larger foam requires more intensive drying because of the longer distance the solvent must pass from the interior of the foam to the exterior. A sol-gel that is dried in a mold or container will require that the liquid travel through the sol-gel to the open surface of the mold or container in order for the liquid component to be removed. (page 9, line 29-page 10, line 4). Thus, the ability to dry a foam is limited by its smallest dimension (*i.e.*, the distance the liquid must travel to be removed).

At the time of applicants' invention, the available drying processes required that liquid had to travel through the sol-gel. Using the known processes to dry a monolith in which its smallest dimension (*i.e.*, the distance the liquid had to travel) was large would have lead to uneven or incomplete drying of the monolith. The result would be that internal strains would form within the foam that would lead to cracking and shrinking. Thus, at

least one dimension of the foam was required to be small to provide the liquid with a relatively short path to travel. (page 11, lines 16-26).

Accordingly, because Hrubesh does not teach or suggest making a monolithic aerogel in which its smallest dimension is greater than about 3 inches, this obvious rejection should be withdrawn and claims 1 and 2 should be allowed.

Claims 3-36, 53, 84, 85, 91-93, 95-112 and 114

The remaining group 1 claims have also been rejected as being anticipated by and/or obvious over certain cited patents. Applicants traverse these rejections. However, solely to expedite prosecution, applicants have amended claims 3-6, 14-16, 25, 27 and 29 to each depend from claim 1 and/or claim 2. Thus, these claims are allowable for at least the reasons discussed above that claims 1 and 2 are allowable. And, as a result of these amendments, claims 7-13, 19-24, 26, 28, 30-36, 53, 84, 85, 90-112 and 114 depend directly or indirectly from claim 1 and/or claim 2 and, thus, are likewise allowable. None of the other cited patents cure the deficiencies of Hrubesh, or provide the motivation and reasonable expectation of success that was missing, as discussed above. Claims 17 and 18 have been canceled to avoid claiming duplicative subject matter, thus obviating the Examiner's rejection.

Rejections of the Group 2 Claims

Claim 37 stands rejected as allegedly being anticipated by Ramamurthi et al., United States Patent 5,036,555 (hereinafter "Ramamurthi"). Applicants traverse.

Applicants' invention, as defined by claim 37, is a small pore area material comprising acetic acid. By incorporating acetic acid into the small pore area material, the resulting material has increased strength. As stated in applicants' specification (page 54, lines 14-20):

acetic acid is retained in the dried gel, even after extended drying. This suggests that it is strongly anchored to the network by hydrogen-bonding, or it would have evaporated during drying. This is consistent with

[applicants'] hypothesis that acetic acid strengthens the gel by way of the hydrogen-bonding mechanism.

The Examiner contends that Example 7B of Ramamurthi discloses a small pore area material comprising acetic acid. Applicants disagree. The silica gel *product* disclosed in Ramamurthi does not comprise acetic acid. Rather, Ramamurthi discloses the use of acetic acid as a catalyst in the *process* to make the silica gel.

More specifically, Ramamurthi discloses a method for making monolithic inorganic aerogels containing reinforcing fibers starting from a metal alkoxide. The alkoxide may be hydrolyzed with various organic acids and bases, including acetic acid, as well as, for example, HCl, HNO<sub>3</sub>, HF. (column 5, lines 24-27). Thus, as described in Example 7B, the silica alkoxide undergoes acid-catalyzed hydrolysis to form a hydrolyzed silicon precursor (molar ratio of silica alkoxide : acetic acid is 1 : 0.39). As the Examiner will appreciate, the acid catalyst used in an acid-catalyzed hydrolysis reaction is not consumed in the reaction process and does not form part of the product. Thus, acetic acid, the acid catalyst in Ramamurthi Example 7B, is not consumed in the reaction process and does not form part of the hydrolyzed silicon precursor or the final silica gel end product.

Accordingly, because Ramamurthi does not disclose a small pore area material comprising acetic acid, the rejection under 35 U.S.C. § 102 should be withdrawn and claim 37 should be allowed.

Claim 38 stands rejected as allegedly being obvious over Hrubesh in view of Parkinson, United States Patent 5,190,987 (hereinafter "Parkinson"). Also, although the Examiner has not rejected claim 37 as obvious, applicants address the nonobviousness of both claims 37 and 38.

In this rejection, the Examiner states that Hrubesh discloses the use of an organic solvent in the preparation of an aerogel. The Examiner further states that although "Hrubesh does not specifically disclose the use of acetic acid as a solvent . . . Parkinson, however, discloses the production of the organic aerogel being treated with acetic acid." (Office Action at p. 9) The Examiner then contends that it would have been obvious to combine the teachings of Hrubesh and Parkinson and "employ acetic acid as a solvent of the

sol-gel polymerization process motivated by the desire to increase the degree of crosslinking and thus stabilize the network." (*Id.*) Applicants traverse.

Applicants' invention, as defined by claims 37 and 38, is a small pore area material comprising acetic acid. In other words, the small pore area material product itself must include acetic acid.

As an initial matter, it was applicants' discovery that the use of a carboxylic acid solvent constitutes a cross-linking mechanism by providing a complex between the hydroxylated aromatics and the carboxylic acid (page 17, lines 15-30; page 28, line 28 – page 30, line 4). At the time of applicants' discovery, only covalent crosslinking, formed between molecules of the small pore area material, was known. It was also applicants' discovery that such carboxylic acid cross-linking results in a more robust sol-gel which is relatively more tolerant of stresses from evaporative, centrifugal, gas pressure or vacuum drying methods than are prior art sol-gels. Prior to applicants' discoveries, such benefits were not known and, thus, could not have motivated one to combine the references as the Examiner suggests. *See MPEP § 2143.*

Next, neither Hrubesh and Parkinson teaches or suggests a small pore area material comprising acetic acid, let alone the benefits of carboxylic acid cross-linking. As discussed above, Hrubesh teaches a method of creating hydrophobic aerogels by treating pre-formed aerogels with a surface modifying agent. Parkinson teaches a method of drying aerogels to prevent surface tension distortion. The aerogels used in Hrubesh and Parkinson are prepared according to the Pekala patents or Pekala, Journal of Materials Science, 24, 3221 (1989), respectively.\* In these methods, the aerogel is either (a) formed in a water solvent and then treated with an acid-wash, or (b) formed in propanol in the presence of an acid catalyst, such as toluenesulfonic acid, phosphoric acid or QUACORR 2001 (*i.e.*, non-

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\* For the Examiner's convenience, applicants attach a copy of Pekala, Journal of Materials Science, 24, 3221 (1989), as Exhibit 1.

carboxylic acids). See, e.g., Parkinson, col. 2, lines 34-52; col. 3, lines 12-14 and the '878 patent, col. 4, lines 37-48.

The only context in which any carboxylic acid is mentioned in either Hrubesh or Parkinson, or the documents cited therein, is in the acid-wash step performed on the pre-formed aerogel. See, e.g., Parkinson, col. 2, lines 34-40. In this acid-wash step, trifluoroacetic acid is merely a catalyst in an acid-catalyzed condensation reaction to promote further crosslinking of the gel, *after* the gel is formed. Indeed, the Examiner acknowledges that the Parkinson aerogel is "being *treated* with acetic acid." (Office Action at p. 9 (emphasis added)). Thus, although the *process* used to treat the gel uses trifluoroacetic acid as a catalyst, there is no teaching or suggestion that the *product* disclosed comprises acetic acid, as required in claims 37 and 38. Nor would one expect a catalyst to form part of the final product, again as required in claims 37 and 38.

Moreover, the Examiner's contention that that one of skill in the art would use acetic acid as a solvent in a sol-gel polymerization is without merit. The only support the Examiner points to is Parkinson's use of a trifluoroacetic acid catalyst in *treating* a pre-formed aerogel with catalytic trifluoracetic acid. Using an acid as a catalyst does not provide the requisite motivation to use a carboxylic acid as a solvent in a sol-gel polymerization reaction. As an example, a skilled artisan, having used hydrochloric acid as a catalyst, would not use it as a solvent. Nor does using an acid catalyst provide the requisite motivation to incorporate a carboxylic acid into a small pore area material.

Accordingly, neither Hrubesh and Parkinson teaches or suggests a small pore area material comprising acetic acid and thus, the rejection under 35 U.S.C. § 103 should be withdrawn and claims 37 and 38 allowed.

#### Rejections of the Group 3 Claims

Claims 40, 41, 45-47, 49 and 51, 115, 116, 120-122, 124 and 126 stand rejected as allegedly being anticipated by, or in the alternative, obvious over, each of Hrubesh, Pekala, United States Patent 5,744,510 (hereinafter "Pekala") and Tennent, United

States Patent 6,099,965 (hereinafter "Tennent"). Claims 48, 50, 123 and 125 stand rejected as being anticipated by, or in the alternative, obvious over, each of Hrubesh and Pekala. Claims 42-44 and 117-119 stand rejected as being obvious over Pekala in view of Parkinson and as being obvious over Tennent in view of Parkinson.

Claims 40 and 115

As discussed above, independent claims 40 and 115 have been amended to incorporate the limitations of former dependent claims 42 and 117. Applicants submit that these amendments obviate the anticipation rejections of independent claims 40 and 115 and their dependent claims. Applicants address each of the obviousness rejections of claims 40 and 115 individually below.

Pekala And Parkinson

The Examiner states that although "Pekala does not specifically disclose the low density microcellular material comprising an acetic acid, Parkinson, however, discloses the production of an organic aerogel being treated with acetic acid (column 2, lines 35-40)." (Office Action at pp. 9-10). The Examiner then contends that "[i]t would have been obvious to one having ordinary skill in the art at the time the invention was made to employ acetic acid as a solvent of the sol-gel polymerization process motivated by the desire to increase the degree of crosslinking and thus stabilize the network." (Office Action at p. 10). Applicants traverse.

Applicants' invention as defined by amended claims 40 and 115 is a small pore area material or low density microcellular material "comprising a hydroxylated aromatic; a solvent comprising a carboxylic acid; and an electrophilic linking agent." As discussed above, applicants discovered that the use of a carboxylic acid solvent constitutes a cross-linking mechanism by providing a complex between the hydroxylated aromatics and the carboxylic acid and that such cross-linking results in a more robust sol-gel which is relatively more tolerant of stresses from evaporative, centrifugal, gas pressure or vacuum drying methods than are prior art sol-gels.

Neither Parkinson nor Pekala teaches or suggests a small pore area material or a low density microcellular material comprising, for example, a solvent comprising a carboxylic acid, as required by claims 40 and 115. As discussed above, Parkinson teaches a process used to treat a pre-formed gel with catalytic trifluoroacetic acid. The aerogel in Pekala is prepared in much the same manner as in the '848 patent, *i.e.*, an acid catalyzed condensation reaction in propanol solvent. *See, e.g.*, Pekala, col. 4, lines 36-47. Again, although the patents teach a process using catalytic acid, there is no teaching or suggestion that the product disclosed comprises acetic acid.

Once again, the Examiner's contention that one of skill in the art would use acetic acid as a solvent in a sol-gel polymerization is without merit. The only support the Examiner points to is Parkinson's use of a trifluoroacetic acid catalyst in *treating* a pre-formed aerogel with catalytic trifluoracetic acid. As stated above, using an acid catalyst does not provide any motivation whatsoever to use a carboxylic acid as a solvent in a sol-gel reaction, much less the motivation to incorporate a carboxylic acid into a small pore area material or a low density microcellular material.

Accordingly, neither Pekala and Parkinson teach or suggest applicants' claimed invention. Therefore, this rejection under 35 U.S.C. § 103 should be withdrawn.

#### Tennent and Parkinson

The Examiner states that although "Tennent does not specifically disclose the low density microcellular material comprising an acetic acid . . . Parkinson, however, discloses the production of the organic aerogel being treated with acetic acid (column 2, lines 35-40)" (Office Action at p. 10). The Examiner then contends that "[i]t would have been obvious to one having ordinary skill in the art to employ acetic acid as a solvent of the sol-gel polymerization process motivated by the desire to increase the degree of crosslinking and thus stabilize the network." (*Id.*) Applicants traverse for at least the same reasons discussed above.

Neither Tennent nor Parkinson teaches or suggests a small pore area material or a low density microcellular material comprising, for example, a solvent comprising a

carboxylic acid, as required by claims 40 and 115. Tennent discloses methods of producing aerogel and xerogel composites comprising nanofibers. Tennent teaches the use of water (Examples 19 and 20) and ethanol (Example 21) as solvents in the preparation of the fibril-aerogel composites. Further, Parkinson teaches the use of the fluorocarbon solvents. Neither Tennent nor Parkinson make mention of the use of a carboxylic acid solvent. Thus, the combination of Tennent and Parkinson does not teach or suggest applicants' claimed invention.

Accordingly, for the foregoing reasons, the rejections under 35 U.S.C. § 103 should be withdrawn and claims 40 and 115 allowed.

Claims 41, 43-51, 116 and 118-126

Claims 41 and 43-51 depend from claim 40 and, thus, are allowable for at least the reasons discussed above that claim 40 is allowable. Claims 116 and 118-126 depend from claim 115 and, thus, are allowable for at the least the reasons discussed above that claim 115 is allowable. Claims 42 and 116 have been canceled, thus obviating the Examiner's rejections of these claims.

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CONCLUSION

In view of the foregoing remarks, applicants respectfully request reconsideration and early allowance of the pending claims in this application.

Respectfully submitted,



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